Space Weather Technical Forecast

Issued on Thursday, 01 September 2022 at 01:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of M-flares (R1-R2 Blackouts). Chance of G1/Minor Storm Day 4 (03 Sep). Very slight chance of Active fluence later in the period.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity was Low, with no significant flare activity. Ex-AR3088 has now fully rotated from view and no longer presents a flare risk. AR3089 (Fac/βγδ) presents the most significant flare risk, but currently appears stable. AR3090 (Axx/α) is a new and benign region. No new CMEs have been observed on available imagery.

Solar Wind / Geomagnetic Activity: Solar wind speeds have eased to 500km/s from a peak of 610km/s as the high speed stream from coronal hole 17 wanes, Density was around average. Total interplanetary magnetic field strength was Moderate, but briefly fell to weak during the period. The north-south component, Bz, initially varied weakly, but has almost reach moderate levels over the last six hours due to an increasing amplitude in the variations. Phi angle was negative (towards the Sun) throughout. Geomagnetic activity was mainly Quiet to Unsettled (Kp1-3) with one Active interval between 31/2100-0000UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured by GOES-16, is at background levels. The high energy electron flux (greater than 2 MeV) remained at background levels. The 24-hour integrated electron fluence remained below the Active threshold (1e8 integrated pfu) with 2.24e6 integrated pfu observed at 01/0000 UTC with a rising trend.

Four-Day Space Weather Forecast Summary
Solar Activity: Activity is Low. There is a slight chance, however, of isolated M-flares from AR3089, with a very slight chance of X-flares.

Solar Wind / Geomagnetic Activity: A filament eruption on 30 August produced a CME which may give a glancing blow at Earth, most likely later on day 3 (03 September). Solar wind speeds are expected to decline through day 1 (01 September). Increases are then forecast from later on day 2 onwards due to the connection with two consecutive high speed streams. The first is due to connect later on 02 September with the second likely to affect the Earth from either late on 03 September or during 04 September.

Geomagnetic activity is expected to be Quiet to Unsettled on day 1, perhaps with an isolated Active interval at first. Further Unsettled to Active intervals are then possible through days 2 to 4, with a chance of G1/Minor Storm intervals due mainly to the effects of the coronal hole high speed streams and any preceding CIR (co-rotating interaction region), along with a potential CME arrival on day 3.

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Energetic Particles / Solar Radiation: High energy protons (greater than 10 MeV) are expected to remain below S1/Minor radiation storm levels, but with a slight chance of reaching S1 or above should any significant flares occur from AR3089. The high energy (greater than 2 MeV) electron flux is likely to remain mostly at background levels, but perhaps reaching moderate to high on diurnal peaks as solar winds ease. Corresponding 24 hour fluence levels are likely to remain below the Active threshold, with a rising trend later in the period.

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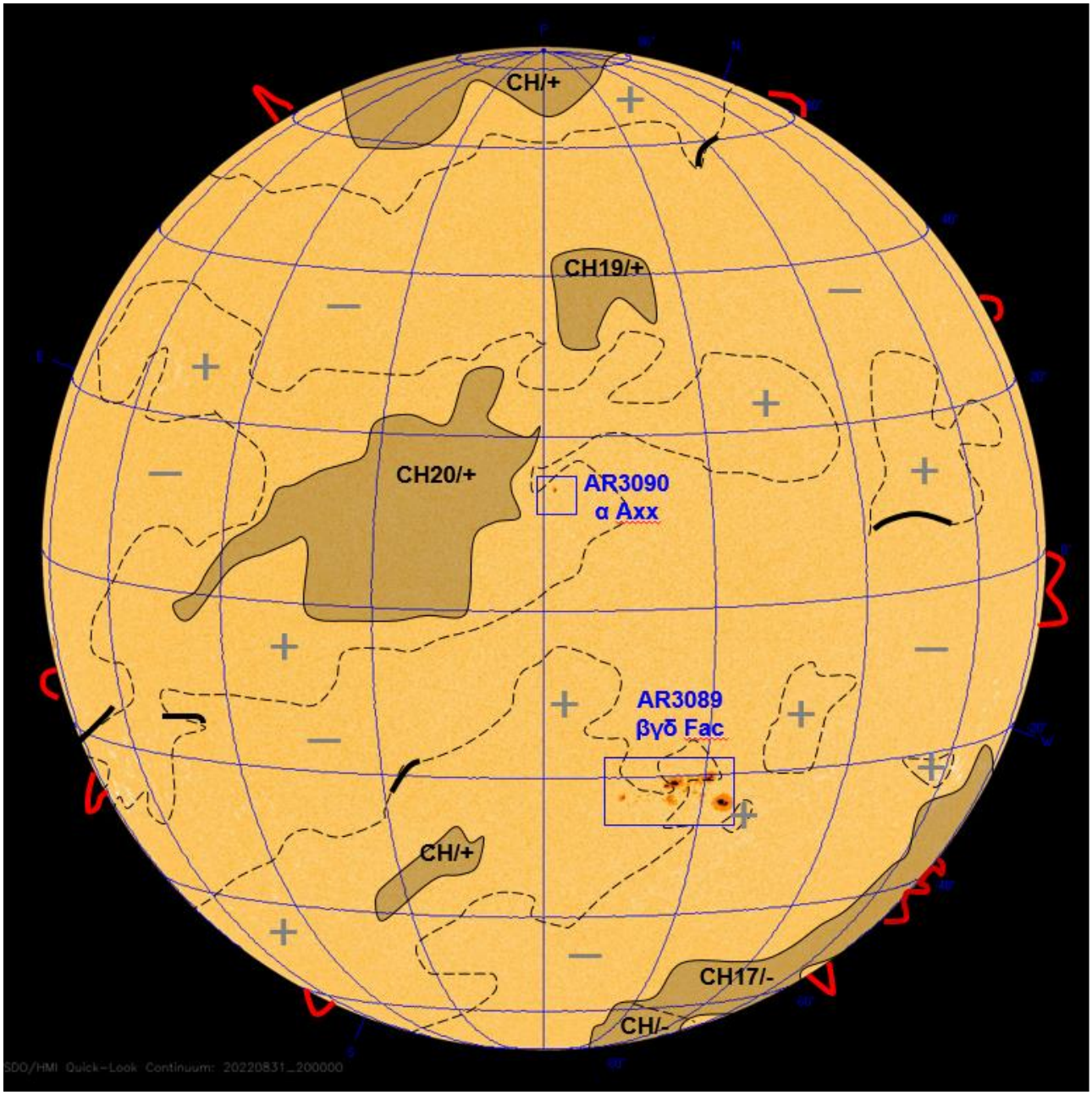
Figure 1. Solar Analysis Valid 31/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A filament eruption, seen leaving the southeast of the solar disc around 30/1500UTC has been modelled and has a potentially Earth-directed component. Although the main portion of the CME is forecast to pass to the south of the Earth, there is the chance of a glancing blow, perhaps later on day 3 (03 September).

Otherwise solar winds are following a steady decline as the Earth slowly leaves the influence of a CME which is considered to have affected the Earth on 30 August. Some aspect of the increased solar winds speeds may also be due to the Earth brushing the edge of a CIR from the high speed stream of coronal hole 17. Although winds may steadily fall towards background, a connection to the high speed stream from coronal hole 19 is then possible late on day 2 (02 September). A connection to coronal hole 20 is then forecast either late on day 3 or during day 4 (04 September).

Geomagnetic activity is expected to be Quiet to Unsettled on day 1, perhaps with an isolated Active interval at first. Further Unsettled to Active intervals are then possible through days 2 to 4, with a chance of G1/Minor Storm intervals due mainly to the effects of the coronal hole high speed streams and any preceding CIR (co-rotating interaction region), along with the potential CME arrival on day 3.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	30	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
31/0204	Partial	Filament	SE quadrant	420 km/s	03/1800UTC	Limited shock – glancing blow.

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Figure 2: Enlil ensemble, showing potential timing of CME

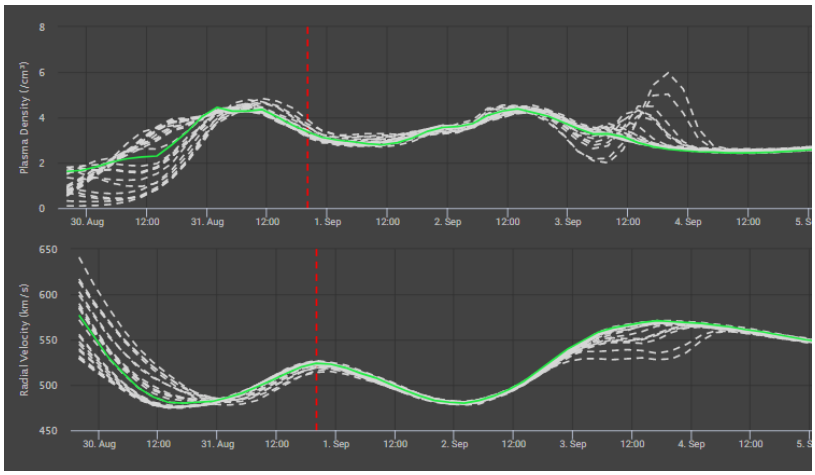
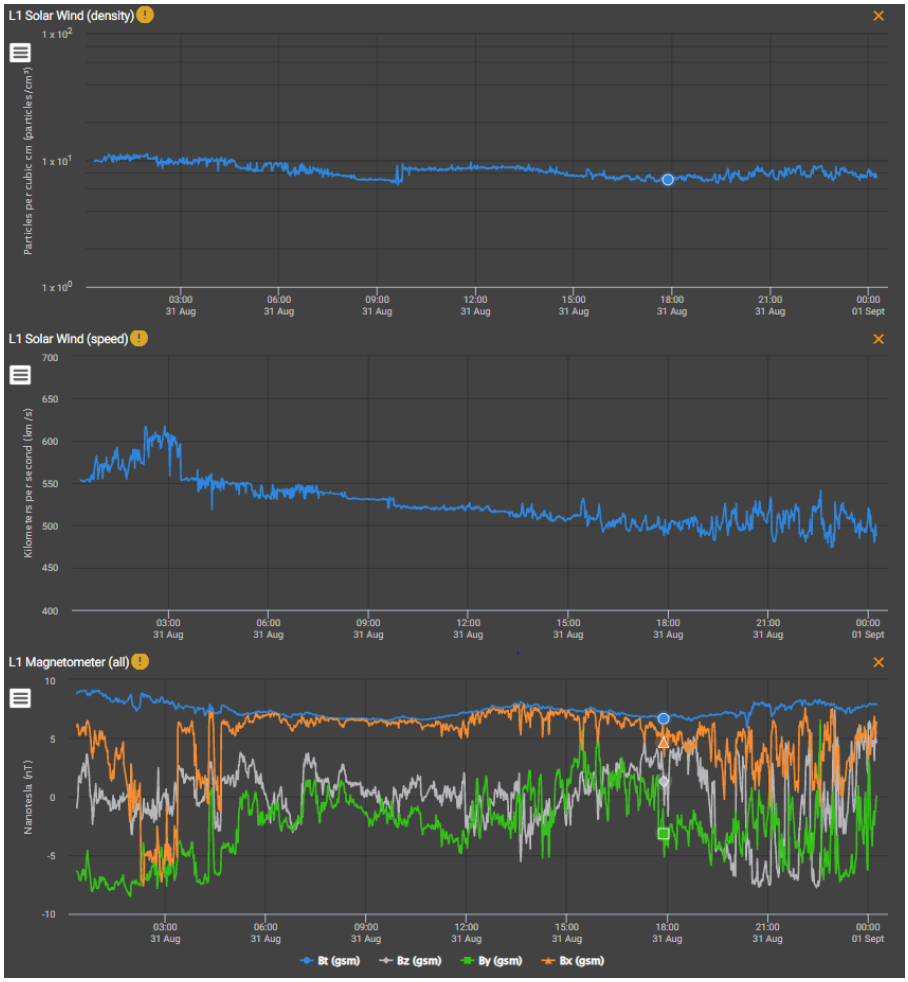


Figure 3: Recent L1/DSCOVR solar wind parameters



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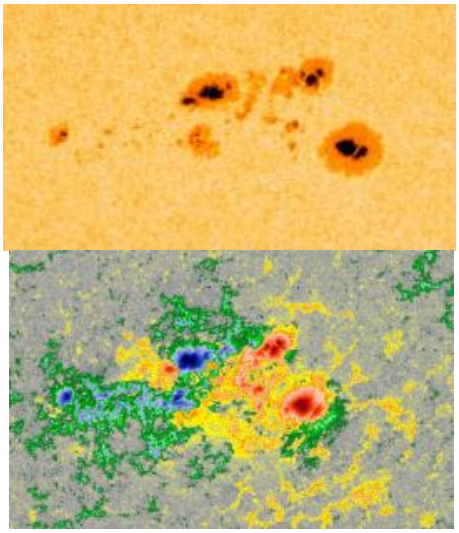
Radio Blackouts - X-Ray Flares:

Solar activity has been Low over the last 24 hours with no M-class flares observed. Ex-AR3088 has now rotated so far round the limb that looping is no longer visible. Consequently this region is no longer considered a flare risk.

The most significant region is currently AR3089 (Fac/βγδ), which is large, but has produced limited solar activity, with relatively organised magnetic looping. This provides the greatest flare risk though, with a chance of M-class flares and a slight chance of X-class flaring. The further region in the northern hemisphere is not considered to present a notable risk.
Looping on the eastern limb suggests a potential increase in activity, with further active regions possibly rotating onto the Earth-facing disc. These will continued to be monitored for an increasing risk.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	20	20	20	20
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 4: AR3089 on the south-centre disc.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) is now at background values after recent enhancements. The continued influence of ex-3088 has previously led to a slightly increased possibility of proton events, but this region is has now rotated far enough across the horizon to be a significantly reduced risk.

AR3089 (Fac/βγδ) despite apparent stability, continues to present a slight chance of a proton event at Earth should there be any significant flaring. This risk will continue as the region rotates across the southwestern quadrant.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is expected to increasingly exceed the high (1e3 pfu) threshold as solar winds ease and radiation belts relax into their natural orbits. However further increasing winds from high speed streams and potential periods of heightened geomagnetic activity could inhibit the forecast sustained increase in electron flux.

Corresponding electron fluence is expected to follow a steadily rising trend during the next four days, due to increasing electron counts, but this is subject to the absence of significant geomagnetic activity or significant increases in the solar wind speeds.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	10	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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